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Seasonal incidence of leaf miner (*Aproaerema modicella*) on groundnut (*Arachis hypogaea* L.) during rabi season

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Abstract

Seasonal incidence of *A. modicella* in groundnut was studied during *rabi*, 2015-16 at S.V. Agricultural College, Tirupati in two groundnut varieties *i.e.*, Dharani and Kadiri-6 (K6). The results indicated that, the D₃ (December second fortnight) and D₄ (January first fortnight) sown groundnut crop, foliar damage due to leaf miner was high when compare with D₁ (November second fortnight) and D₂ (December first fortnight) sown crops during 6th standard week to 11th standard week of 2016. Weather parameters like wind speed showed a positive association with leaf miner incidence in terms of foliar damage and maximum temperature, minimum temperature showed a positive association with leaf miner incidence in D₂, D₃, D₄ showed a negative association in D₁. All the six weather parameters combinedly influenced the damage to the extent of 56 per cent ($R^2=0.566$), 56 ($R^2=0.564$) in D₁ and 58 per cent ($R^2=0.583$), 48 percent ($R^2=0.482$) in D₂, 79 per cent ($R^2=0.79$), 75 per cent ($R^2=0.75$) in D₃ and in D₄ sown crop all the weather parameters were influenced the damage up to 66 and 69 per cent ($R^2= 0.66$ and 0.69) in Dharani and K-6 respectively.

Keywords: Seasonal incidence, *rabi*, *Arachis hypogaea*, *Aproaerema modicella*

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop of tropical and sub-tropical regions of the world. India ranks first in groundnut cultivation with an area of 5.53 m ha and occupies second place in production (9.67 million tonnes) with productivity of 1750 kg ha⁻¹. In India, groundnut is mostly grown in five states *viz.*, Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra which accounts for 80 per cent of total area and 84 per cent of total production of groundnut. In Andhra Pradesh, groundnut is grown in an area of 13.86 lakh hectares with a total production of 7.48 lakh tonnes and productivity of 644 kg ha⁻¹ [8].

Studies revealed that 15 - 20 per cent of the total oilseed produced is lost directly or indirectly by the attack of insect and mite pests every year. In groundnut crop, some of the insect pests cause considerable yield losses. Among these insect pests, white grub cause yield losses up to 20-100 per cent, tobacco caterpillar causes up to 15-30 per cent, red hairy caterpillar causes up to 75 per cent, leaf miner causes up to 49 per cent, jassids causes yield losses up to 17 per cent, thrips causes up to 17 per cent yield losses [5].

The groundnut leaf miner, *Aproaerema modicella* Deventer, belongs to family Gelechiidae, order Lepidoptera. It is an Oligophagous pest and feeds only on leguminous host plants and a serious pest of groundnut in both rainy and post rainy season in India and of groundnut and soybean in South and South East Asia. The leaf miner is considered as the most important insect pest of groundnut in India and particularly in rain fed situations [3].

As a result, the leaflets turn brown, shrivel and dry up. Severely infested crop gives a burnt up appearance and yield losses can reach upto 76 per cent [1]. Hence the present studies were conducted at S.V. Agricultural College Farm, Tirupati during *rabi*, 2015-16.

Materials and Methods

A field trial was conducted with two groundnut varieties Kadiri-6 (K-6) and Dharani to study the seasonal incidence and influence of various weather parameters on incidence of *S. litura* during *rabi* 2015-16. The trial was laid out in observational trial of 5x5m² area under four dates of sowing *i.e.*, second fortnight of November (D₁), first fortnight of December (D₂),

second fortnight of December (D₃) and first fortnight of January (D₄) by following normal agronomic practices except for plant protection developed by ANGRAU.

The incidence of *A. modicella* was initiated from 28 days after sowing (DAS). Data on incidence of *A. modicella* in terms of damaged plants was recorded from the total number of plants/m² and number of leaves damaged by *A. modicella*. Similarly, weather parameters were recorded on a daily basis from meteorological station and compiled to the standard week wise for analyzing the data.

For *A. modicella* per cent damage was calculated by using the following formula

$$\text{Per cent damage} = \frac{\text{Number of leaves damaged per plant}}{\text{Total number of leaves per plant}} \times 100$$

Results and discussions

During *rabi* 2015-16 field incidence of leaf miner in terms of foliar damage was recorded from 52nd standard week of 2015 to 17th standard week of 2016 in all the four dates of sowings (November II fortnight, December I fortnight, December II fortnight and January I fortnight) of two groundnut cultivars *i.e.*, Dharani and Kadiri-6 (K-6).

The data indicated that the leaf miner damage was first noticed in 52nd standard weeks of 2015 and 2nd, 3rd and 4th standard weeks of 2016 in D₁, D₂, D₃ and D₄ sown crops, respectively. In D₁ damage was ranged from 2.12 to 11.96 and 1.87 to 11.23 per cent in Dharani and K-6 varieties. In case of D₂ sown crop, the incidence was ranged from 4.75 to 23.76 per cent in Dharani and 4.35 to 25.35 per cent in K-6 variety. In D₃ sown crop, the incidence was 0.24 to 31.83 per cent in Dharani and 5.5 to 25.28 per cent in K-6. Similarly, in D₄ sown crop, the incidence was 0.38 to 38.46 per cent in Dharani and 5.42 to 41.59 per cent in K-6.

In D₃ and D₄ sown groundnut crop, foliar damage due to leaf miner was high when compare with D₁ and D₂ sown crops. Infestation was high during the 6th standard week to 11th standard week of 2016 which were coinciding with 5th February to 18th March. Incidence was 15.54 to 31.83 and 15.48 to 24.21 in D₃ and 15.64 to 38.46 and 19.92 to 41.59 per cent in D₄ in both cultivars Dharani and K-6 respectively. Thereafter the incidence of leaf miner was declined in both the cultivars (Table. 1, Fig. 1, Plate. 1,2).

The results of the present investigations are in accordance with the results of Pazhanisamy and Hariprasad [7] who reported that *Aproaerema modicella* was noticed from 5th MSW (Meteorological Standard Week) to 14th MSW (28 per cent to 88.5 per cent) and 33rd standard week to 42nd standard week (10.5% to 92%), during the *rabi* and *kharif* season of 2010, respectively. Maximum larval population was recorded on the 9th standard week (7.4 larvae plant⁻¹) and 38th standard week (4.8 larvae plant⁻¹) and also it was coincided with highest per cent infestation of *A. modicella* during *kharif* and *rabi* season, respectively. Infestation of *A. modicella* was observed at 4th MSW to 12th MSW (21.5 per cent to 85.6 per cent) during the *rabi*, 2011 while in *kharif* 2011, it was noticed on 33rd MSW to 44th MSW, which was ranged from 22 per cent to 86.5 per cent. Correlation studies between incidence of larval population and weather parameters revealed that significant positive correlation with minimum temperature while relative humidity showed significant negative correlation during *rabi* and *kharif* seasons.

Present investigations are also supported by the results of Hanamant Gadad *et al.* [6] who reported that the incidence of leaf miner was observed from 5th to 12th MSW with peak incidence between 8th and 9th MSW.

Correlation studies on the influence of weather parameters like maximum and minimum temperature, morning and evening relative humidity, sunshine hours and wind speed on foliar damage due to leaf miner were carried out during *rabi*, 2015-2016. Weather parameters like wind speed showed positive association with leaf miner incidence in terms of foliar damage and maximum temperature, minimum temperature showed positive association with leaf miner incidence in D₂, D₃, D₄ showed negative association in D₁. On the contrary, evening relative humidity showed a negative association with leaf miner damage in groundnut and morning relative humidity showed a positive association in D₁ and D₂ sown Dharani variety, negative association with K-6 in D₂, D₃ and D₄ sown crop. Sunshine hours showed a negative association with leaf miner incidence in D₁ and D₂ and showed positive association with D₃ and D₄ sown crop.

In D₁ and D₂ sown crop weather parameters did not show significant influence on leaf miner incidence in two cultivars of groundnut (Dharani and K-6). In case of D₃ sown crop, the influence of evening relative humidity ($r = -0.53$, $r = -0.60$) was highly significant. In case of D₄ sown crop evening relative humidity ($r = -0.58$, $r = -0.59$) influenced the foliar damage of leaf miner significantly and remaining weather parameters were not significant (Table. 2, Fig. 2).

The present results are supported by Arunachalam and Zadda Kavitha [2] who reported that the incidence of leaf miner on groundnut was increased with raise in maximum temperature and decrease in relative humidity.

Regression analysis on influence of weather parameters *viz.*, Maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, sunshine hours and wind speed on foliar damage caused by the *A. modicella* indicated that all the weather parameters together resulted in extent of 79 per cent ($R^2=0.79$), 75 per cent ($R^2=0.75$) in Dharani and K-6 in D₃. Among the all the weather parameters maximum temperature and evening relative humidity influenced on the damage caused by the leaf miner in Dharani up to the extent of 48 per cent ($R^2=48$) and in K-6 up to 55 per cent ($R^2=0.55$). Regression equations were developed by using the forward selection were $Y = 181.343 + (-3.249) \text{ Max temp.} + (-1.310) \text{ RHeve.} + 8.777$ and $Y = 164.972 + (-2.889) \text{ Max temp.} + (-1.236) \text{ RH eve.} + 7.416$. In D₄ sown crop all the weather parameters were influenced the damage up to 66 and 69 per cent ($R^2 = 0.66$ and 0.69) and among these two parameters influenced on the damage caused by the leaf miner in Dharani up to the extent of 42 per cent ($R^2 = 0.42$) and in K-6 up to 44 per cent ($R^2 = 0.44$).

Regression equations developed by using the forward selection were $Y = 146.700 + (-2.349) \text{ Max temp.} + (-1.202) \text{ RH eve.} + 10.468$ and $Y = 156.776 + (-2.491) \text{ Max temp.} + (-1.293) \text{ RHeve.} + 10.985$ in Dharani and K-6, respectively (Table. 3).

Present investigations are supported by Birajdar *et al.* [4] who reported that coefficient of multiple regressions (R^2) between weather parameters and population of leaf miner on groundnut was highly significant ($R^2 = 98.5$) showing the weather parameters influencing the abundance of leaf miner on groundnut.

Table 1: Population dynamics of *A. modicella* on groundnut during *rabi*, 2015-16.

Standard week	Weather parameters						% of foliage damage by Leaf miner							
	Max. temp (°C)	Min. temp (°C)	RH mor. (%)	RH eve. (%)	SSH (hours)	WS (kmph)	D ₁ (Nov II FN)		D ₂ (Dec I FN)		D ₃ (Dec II FN)		D ₄ (Jan I FN)	
							Dharani	K6	Dharani	K6	Dharani	K6	Dharani	K6
50 (10-16, Dec)	30.4	20.6	91.9	63.9	6.6	2.2	0	0	0	0	--	--	--	--
51 (17-23, Dec)	31.0	19.7	91.0	63.6	8.2	2.0	0	0	0	0	--	--	--	--
52 (24-31 Dec)	29.7	18.1	88.0	60.6	7.7	4.7	2.12	1.87	0	0	0	0	--	--
1(1-7, Jan), 2016	30.0	16.5	90.1	58.0	8.5	3.8	4.25	2.37	0	0	0	0	--	--
2(8-14, Jan)	29.6	14.8	89.1	54.7	8.0	3.4	5.39	7	4.75	7.77	0	0	0	0
3 (15-21, Jan)	30.0	17.9	91.9	60.7	5.6	3.0	4.28	4.59	5.07	4.35	0.24	0	0	0
4(22-28, Jan)	30.7	20.4	91.7	58.7	6.2	5.1	4.77	5.01	7.28	6.11	10.99	5.5	0.38	0
5(29-Jan-4 Feb)	33.1	16.9	84.7	33.7	9.0	2.9	4.13	4.06	9.45	8.15	16.83	19.37	17.14	17.87
6(05-11, Feb)	32.4	18.6	89.6	41.7	7.8	3.5	7.6	6.33	14.74	10.14	30.33	23	15.64	19.92
7(12-18, Feb)	32.5	19.1	88.9	48.0	8.8	4.3	11.96	11.23	21.03	18.6	21.26	23.75	20.89	22.72
8(19-25, Feb)	34.6	21.1	87.0	39.1	9.6	4.2	8.76	7.67	23.76	24.42	31.83	24.21	36.86	41.59
9(26-Feb-04-Mar)	33.15	21.29	87.13	43.00	7.26	4.39	8.02	10.37	22.33	25.35	23.6	22.06	38.46	38.03
10(5-11, Mar)	34.54	22.11	86.00	38.14	7.80	3.93	11.03	9.6	18.5	21.74	29.04	25.28	29.95	33.76
11(12-18, Mar)	36.60	25.53	79.71	41.43	6.24	4.51	9.53	8.64	19.96	22.33	15.54	15.48	25.99	27.78
12(19-25, Mar)	39.19	24.90	72.14	27.00	7.61	3.96	7.89	8.18	13.32	17.64	20.32	20.85	23.69	24
13(26, Mar -01, April)	36.27	23.43	77.67	33.33	8.35	4.07	--	--	12.92	15.14	18.51	18.93	21.41	21.32
14(2-8, April)	36.4	23.7	77.0	34.0	8.3	4.0	--	--	--	--	16.06	17.27	13	14.59
15(9-15, April)	38.3	25.7	76.7	33.7	8.3	4.2	--	--	--	--	15.36	16.89	9.37	11.43
16(16-22, April)	39.4	26.0	75.9	30.6	8.9	4.6	--	--	--	--	--	--	6.55	8.72
17(23-29, April)	39.9	27.0	74.4	33.0	9.9	4.5	--	--	--	--	--	--	4.59	5.42

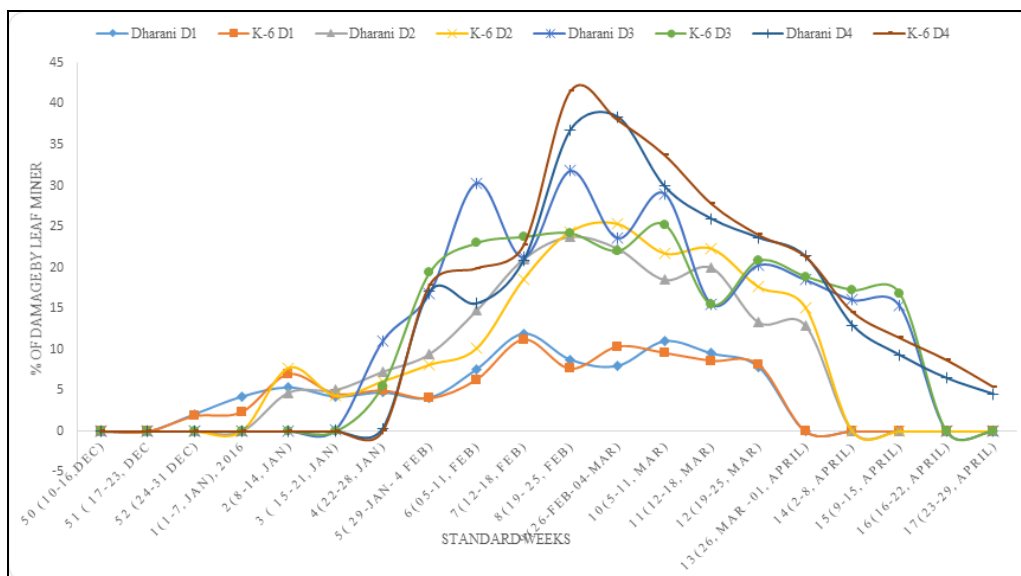


Fig 1: Incidence of *A. modicella* on groundnut during *rabi*, 2015-16.

Table 2: Correlation studies of groundnut leaf miner in relation to weather parameters during *rabi* 2015-16

Weather parameter	D ₁		D ₂		D ₃		D ₄	
	Dharani	K-6	Dharani	K-6	Dharani	K-6	Dharani	K-6
Maximum temperature (X1)	-0.13	-0.14	0.07	0.13	0.26	0.32	0.38	0.39
Minimum temperature (X2)	-0.21	-0.21	0.01	0.08	0.15	0.19	0.29	0.30
Morning RH (X3)	0.24	0.23	0.06	-0.02	-0.12	-0.22	-0.25	-0.25
Evening RH (X4)	-0.07	-0.06	-0.29	-0.32	-0.53*	-0.60*	-0.58*	-0.59*
Sunshine hours (X5)	-0.14	-0.20	-0.04	-0.06	0.13	0.17	0.16	0.19
Wind speed (X6)	0.22	0.22	0.25	0.26	0.24	0.21	0.28	0.28

r value at 0.05 is 0.53

* Significant at 5%.

D₁: Date of sowing: 27-11-2015

D₂: Date of sowing: 12-12-2015

D₃: Date of sowing: 27-12-2015

D₄: Date of sowing: 11-01-2016

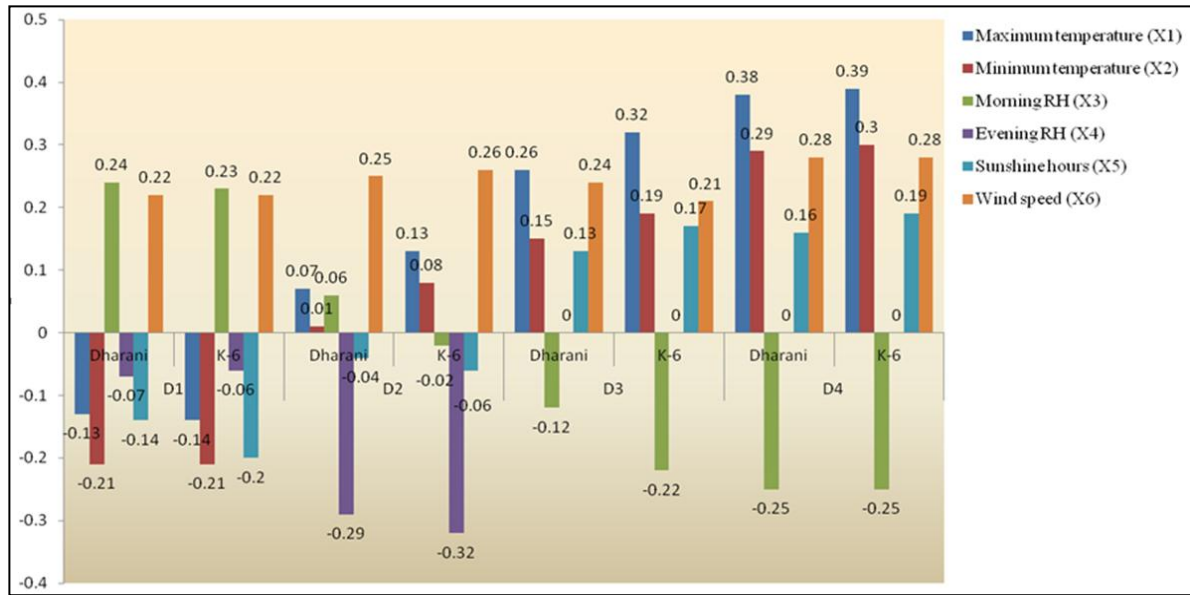


Fig 2: Correlation studies of groundnut leaf miner in relation to weather parameters during *rabi* 2015-16.

Table 3: Regression analysis of groundnut leaf miner in relation to weather parameters during *rabi*, 2015-16.

Regression model	Regression equation leaf miner	R ²
Dharani		
D ₁ (Full model)	Y = -126.774 +(2.618) Max temp.+(-1.457) Min temp.+ (1.017) RH mor.+(-0.133) RH eve.+(-1.826) SSH+(2.033) WS+3.289	0.566
D ₁ (Forward selection)	Y = -94.687 +(0.944) Max temp. +(0.712) RH mor.+ (1.811) WS +3.877	25.7
D ₂ (Full model)	Y = -119.040 +(0.179) Max temp.+ (0.430) Min temp.+ (1.949) RH mor.+ (-1.003) RH eve.+ (-2.088) SSH+(2.421) WS+6.934	0.583
D ₂ (Forward selection)	Y = 8.905 +(-0.162) RH eve. +(1.814) WS +8.868	10.9
D ₃ (Full model)	Y = 66.661 +(-5.846) Max temp.+ (3.751) Min temp.+ (1.892) RH mor.+ (-2.121) RH eve.+ (-0.306) SSH+(0.556) WS+6.384	0.793
D ₃ (Forward selection)	Y = 181.343 + (-3.249) Max temp. +(-1.310) RHeve.+8.777	0.48
D ₄ (Full model)	Y = 67.462 +(-5.759) Max temp.+ (4.091) Min temp.+ (1.713) RH mor.+ (-2.060) RH eve.+ (-0.092) SSH+(0.673) WS+9.213	0.660
D ₄ (Forward selection)	Y = 146.700 + (-2.349) Max temp. + (-1.202) RH eve. +10.468	0.42
K-6		
D ₁ (Full model)	Y = -107.765 +(2.399) Max temp.+(-1.444) Min temp.+ (0.901) RH mor.+ (-0.140) RH eve.+ (-2.030) SSH+(1.973) WS+3.222	0.564
D ₁ (Forward selection)	Y = -77.338 +(0.728) Max temp. +(0.593) RH mor.+ (1.777) WS +3.876	0.223
D ₂ (Full model)	Y = -65.922 +(-0.521) Max temp.+ (0.653) Min temp.+ (1.613) RH mor.+ (-1.044) RH eve.+ (-2.461) SSH+(2.291) WS+8.309	0.482
D ₂ (Forward selection)	Y = 10.639 +(-0.199) RH eve. +(1.914) WS +9.425	12.8
D ₃ (Full model)	Y = 143.891 +(-6.145) Max temp.+ (3.392) Min temp.+ (1.124) RH mor.+ (-1.951) RH eve.+ (-2.218) SSH+ (-0.414) WS+6.311	0.756
D ₃ (Forward selection)	Y = 164.972 + (-2.889) Max temp. +(-1.236) RH eve. +7.416	0.55
D ₄ (Full model)	Y = 15.809 +(-5.190) Max temp.+ (4.089) Min temp.+ (2.139) RH mor.+ (-2.157) RH eve.+ (0.095) SSH+ (0.767) WS+ 9.262	0.697
D ₄ (Forward selection)	Y = 156.776 + (-2.491) Max temp. +(-1.293) RHeve.+10.985	0.44



Plate 1: Damage caused by larvae *Aproaerema modicella* on groundnut crop



Plate 2: Leaf miner damaged groundnut plant

Summary and Conclusions

The studies on incidence of leaf miner on groundnut during 52nd standard weeks of 2015 and 2nd, 3rd and 4th standard weeks of 2016 in D₁, D₂, D₃ and D₄ sown crops, respectively. It was concluded that correlation analysis between weather parameters like wind speed showed a positive association with leaf miner incidence in terms of foliar damage. Maximum temperature, minimum temperature showed a positive association with leaf miner incidence in D₂, D₃ and D₄ sown crops and negatively association with in D₁ sown crop. On the contrary, evening relative humidity showed a negative association with leaf miner damage in groundnut and morning relative humidity showed a positive association in D₁ and D₂ sown Dharani variety, negative association with K-6 in D₂, D₃ and D₄ sown crop. Sunshine hours showed a negative association with leaf miner incidence in D₁ and D₂ and showed a positive association with D₃ and D₄ sown crop. In D₁ and D₂ sown crop weather parameters did not show significant influence on leaf miner incidence in two cultivars of groundnut (Dharani and K-6). In case of D₃ sown crop, the influence of evening relative humidity ($r = -0.53$, $r = -0.60$) was highly significant. In case of D₄ sown crop evening relative humidity ($r = -0.58$, $r = -0.59$) influenced the foliar damage of leaf miner significantly and remaining weather parameters were not significant.

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